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Development and Application of Optical Stimuli in Controlled Atmosphere Transmission Electron Microscopy

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Electron microscopy has been used extensively to characterize nanostructures for decades [1]. Adding *in situ* capabilities to electron microscopes opens for characterization of materials under more realistic working conditions. However, maintaining electron microscopy performance during *in situ* studies is challenging [2,3]. Here, we discuss the development of sample holders capable of exposing samples to optical irradiation, as well as the microscope performance during *in situ* experiments.
As an example, cuprous oxide (Cu_2O) has been identified as a promising catalyst for the hydrogen evolution reaction from ethanol-containing aqueous solutions. However, Cu_2O suffers from photocorrosion in the presence of water. Fig. 1 shows the photoinduced degradation of Cu_2O to metallic copper during *in situ* exposure to water vapor and light in the electron microscope. The oxide-to-metal transformation is investigated using complementary electron microscopy techniques [4].

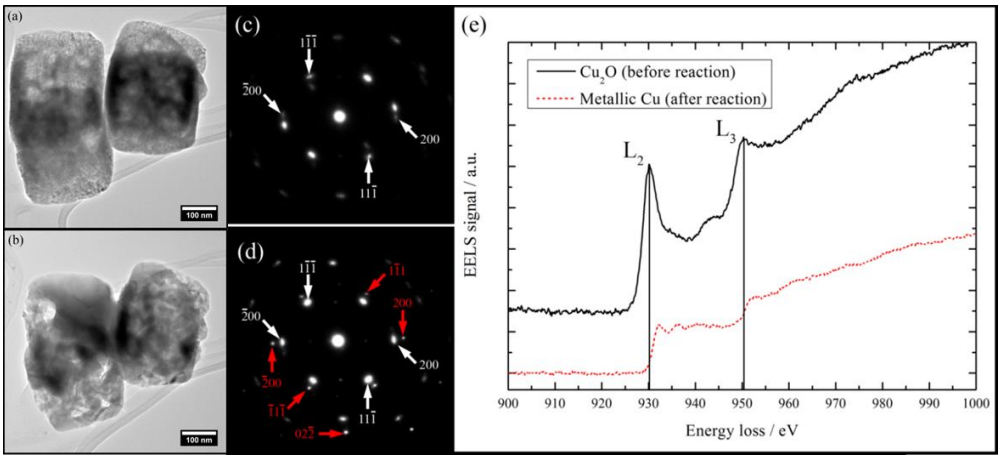

Figure 1: Bright-field images, electron diffraction and electron energy-loss spectra showing the photodegradation of Cu_2O under optical illumination in an aqueous environment.

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